

THE MICROPHONE

WE have received the following communications on this subject:—

At a discussion upon Mr. William Preece's paper on the microphone, which took place before the Society of Telegraph Engineers on Thursday last, the Duke of Argyll called attention to the important part which that invention was likely to play in physiological research. As chairman of the meeting I took occasion to refer to the intimate connection between the microphone and its two elder sisters, the telephone and the phonograph, in conjunction with which it formed a discovery which would probably be hereafter regarded as one of the greatest achievements in natural science of the present century. I ventured further to draw an analogy between the action of the phonograph and the action of the brain in the exercise of memory, and with your permission I will enlarge upon this speculation to the extent of making my reasoning clear enough to submit the same to the critical test.

All impressions received by us from without, either through the tympanum of the ear, the retina of the eye, or through the sensitive nerves of the skin, are, it is generally believed by physiologists, communicated to corpuscular bodies in the brain, which lie embedded in a grey substance, the nature and precise function of which have not yet been fully explained. It would appear that the corpuscular bodies in which the sensitive nerves terminate are connected, through the medium of extremely delicate filaments, with the nervous system of volition, the reaction of the one system upon the other being attributable to mental energy. It may be conceived that any fresh impressions received on the extremely complex sensitive network of the brain may give rise then and there to acts of volition; but how, it may be asked, can acts of volition arise from impressions that were communicated through the sensitive nerves years before, having been committed in the meantime to what we term the memory? But in order that the mind can deal with an impression previously received it seems necessary that it must have the power of reproducing the same from some material record by which the impression has been rendered permanent. Take the case of a tune that we have heard in early youth and which may not have since recurred to us. By some incident or other that tune and the words connected with it become suddenly revived in the mind. If the tune had been sung into a phonograph it could have been reproduced at any time by releasing a spring moving the barrel of the instrument; and it seems a fair question to ask whether the grey substance of the brain may not, after all, be something analogous to a storehouse of phonographic impressions representing the accumulated treasure of our knowledge and experience, to be called into requisition by the directing power of the mind in turning on, as it were, one barrel or another.

Such a hypothesis might possibly serve also to explain how in sleep, when the directing power of the mind is not active, a local disturbance in the nervous system may turn on one or more phonographic barrels at a time, and thus produce the confused images of dreamland! A powerful mind would exercise a complete control over the innumerable barrels constituting our store of knowledge, whereas in a weak mind the impressions of the past would be brought back into evidence in a confused and irregular manner. Such a supposition might also account for the more vivid recollection of impressions received in early life, when the mechanical record stored up in the brain may be supposed to have been more distinctly and indelibly rendered. In speaking of these impressions as phonographic it does not follow that they were originally conveyed through the tympanum of the ear. Mr.

Willoughby Smith, at the meeting above referred to, called attention to the fact that, by substituting crystalline selenium for carbon in the microphone, a ray of sunlight directed upon the selenium produces a noise comparable with that produced by a Nasmyth hammer; and it is quite feasible that the impressions received through the retina of the eye, and the nervous system generally, would be equally susceptible of being recorded in the cerebral storehouse. The record itself might be supposed to be of a mechanical, or, more probably, of a molecular character, the one thing important being that it must be material.

These observations are, no doubt, extremely crude, but may serve possibly to direct the attention of physiologists to a point of interest to their science; nor would it be the first occasion on which a phenomenon of inanimate nature had revealed the secrets of animate organisation.

C. WILLIAM SIEMENS

I HAVE been much interested in your account of the microphone of Prof. Hughes, and I have made, as doubtless many of your readers have also done, the different forms of instrument described by him. The action of the instrument is there apparently attributed to the change of conductivity of the charcoal or carbon or of the mercury globules therein, under the influence of sonorous waves; and whether this is correct is a question worthy of consideration in your columns, and I therefore write more for the purpose of leading others into the inquiry than of making assertions on the subject. My experiments point to another cause, viz., the variation of conducting sectional area of a bad conductor due to the increased or diminished pressure on the point of contact. I am not, of course, referring to the action of the instrument when the vibration is sufficient to absolutely sever the contact, which simply causes the telephone plate to vibrate either in its own period, or some other than that due to the acting sound, as is the case when a musical box is placed on the same table with the instrument; but to the forced or articulate vibrations—the reproduction of the sound acting on the microphone.

Of the several forms of instrument described by Prof. Hughes I have chiefly used that consisting of a rod of charcoal pointed at both ends, supported in a vertical position with its lower point resting in a hollow in a similar piece of charcoal, while its upper end rests against the sides of a similar hollow above. This form is extremely sensitive, and it is difficult to prevent the circuit being broken while having it sufficiently near the source of sound to be reproduced; the sound of a musical box is perfectly rendered, when so far away that there is an absence of jarring from breaks in the circuit; but in talking to the instrument, any rise in the voice breaks contact and produces the jarring sound in the telephone, to the exclusion of all articulation.

I find that any sort of charcoal or carbon will answer, whether soaked with mercury or not; I therefore conclude that the mercury has little or nothing to do with the action. I have tried the effect of sound on rods of carbon and charcoal both saturated with mercury and not so saturated, so arranged that the vibrations could not alter the area of contact, and have obtained no sound whatever from the telephone in the circuit; I therefore conclude that the action takes place at the point or points of contact, and is due to the change of conducting area. To Prof. Hughes is due the credit of inventing a means of varying the electric current with extreme rapidity and slight motion without absolutely breaking the circuit, but I doubt whether a *microphone* is a proper term for describing the instrument. In gently brushing the stand of the instrument, sound is heard in the telephone, but it does not at all follow that what we hear is a magnified reproduction of the brushing sound; for if the rapidity of the vibrations or motion produced by

brushing is insufficient to produce sound, still they may move the charcoal sufficiently to produce alternations of current, each of which may be able to set up vibrations in the telephone plate in its own period, or a modification of it, giving what I call the jarring sound. If, therefore, we have this sound, we know that either the microphone is exposed to sounds so loud as to produce complete break of contact, or that there is a motion going on affecting it, of insufficient rapidity to be audible.

With the object of reproducing the voice or musical notes, I have made the following modification of the instrument:—A ferrotype plate 3 inches in diameter is fastened over a hole $2\frac{1}{2}$ inches in diameter in a thick piece of wood; a flat piece of gas carbon weighing a few grains and having a fine copper wire attached to it is fastened to the top of the plate in the centre; over the piece of carbon is suspended by a wire spring another piece of carbon finely pointed, weighing about $\frac{1}{4}$ oz., and adjusted so as just to touch the carbon plate. The current is then led by the wires through the carbon point, and by careful adjustment of the latter almost any degree of sensitiveness can be attained. Whenever the sound becomes too loud the current is broken, and minute sparks are seen at the carbon point, and the jarring sound is heard at the same time in the telephone. The sound of a musical box is perfectly reproduced when the box is held in the air; the instrument is therefore sensible to sound-waves in air as in solids.

GEO. M. SEABROKE

Rugby

I SEND an account of an experiment with the microphone which may interest some of your readers.

A microphone, made of three pieces of gas carbon (as described by Prof. Hughes) and the primary wire of a Du Bois Reymond's induction-coil, are placed in the circuit of a single Daniell cell. The wires from the secondary coil (pushed home) are attached to the poles of a Lippmann's capillary electrometer. The Daniell and microphone are twenty-five feet distant from the electrometer. If an observer watches the capillary-tube and speaks or sings to the microphone (*which is twenty-five feet distant*) definite and large movements of the mercury-column will be seen. The movements for various letters resemble those which have been previously observed to take place with the telephone, the "w" giving its curious double movement.

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EARTHQUAKE IN VENEZUELA

IN the evening of the 12th of this month a severe earthquake destroyed the town of Cua, in this country. Cua is situated on the left bank of the River Tuy, in $10^{\circ} 8' 15''$ L. N. and $66^{\circ} 55' W.$, Greenw. The height over the level of the Caribbean Sea I found in 1873, by barometrical measurement, 232 metres. It was the centre of a very flourishing agricultural district (annual produce, about 80,000*l.* a year), and had about 3,000 inhabitants.

The weather had been for weeks exceedingly hot, as generally this year in Venezuela. At 5 o'clock in the afternoon, before the earthquake, a temperature of 100° is said to have been noticed, and six days later, at the same hour, I observed myself 95° . The sky was clear, and the moon in perfect brightness. The shock occurred some minutes before a quarter to nine o'clock, and so violent was it that in less than two seconds all the centre of the town was a heap of ruins. It is impossible to fix the exact time of the shock, but it was felt in Carácas at 8h. 41m. 34s., the distance in a straight line between both places being about twenty-six English miles.

The centre of the town was situated on a small hill, about 20 metres over the lower part. The hill is com-

posed of gneiss, micaceous and chloritic schists, rising rather steep towards W.S.W. This hill is surrounded by strata of clay and marl, covered by a deep stratum of alluvial soil, and resting on dark limestone and argillaceous schists, containing numerous crystals of iron pyrites.

Only the upper town was laid waste; the lower part suffered comparatively very little. From actual observations I found that the angle of emergence of the shock was about 60° . The centre cannot have been very deep, as the destruction was limited to a spot measuring only one square mile, although the shock of the transverse wave was felt in places 100 miles distant. The soil had burst at different places, giving issue to water highly impregnated with sulphuretted hydrogen. The shocks continued for several days, and are not yet entirely gone, but no further damage has been caused. About 300 people were killed; the loss of property is said to be about 300,000*l.* sterling.

I have reason to think that this earthquake had nothing to do with volcanic forces, but was due to an interior subsidence or downfall of calcareous rock, as I intend to prove in a special memoir on this subject, as soon as I shall have visited the locality once more.

Carácas, April 30

A. ERNST

OUR ASTRONOMICAL COLUMN

TEMPEL'S COMET, 1873, II.—We continue the ephemeris of this comet, for the latter half of June, as given by M. Schulhof in the Paris *Bulletin International* of May 7. If the calculated epoch of perihelion passage be approximately correct, the intensity of light will be increasing, and the comet would arrive at its least distance from the earth early in July. But the possible error in the mean motion determined from the observations of 1873, may render a search over a wide extent of sky unavoidable, if the comet is to be recovered at the present return. Shortly before the completion of his calculations M. Schulhof informed the writer that the probable error in the mean daily motion would not exceed $\pm 7''$, but this degree of uncertainty involves a difference of nearly ± 20 days in the date of perihelion passage, so that the comet may be found after close search in a position considerably distant from the computed one. As in other similar cases, if the observer has the command of an equatorially-mounted instrument of good aperture, the most promising plan of search will be to commence at the calculated declination for the day, extending the sweep to 30m. or 40m. on each side of the calculated R.A., and to continue the same proceeding for 3° or 4° on each side of the calculated declination. It may be remarked that the computed R.A. for a certain change in perihelion passage, varies more rapidly than the computed declination. Perhaps there is a greater probability of the comet being detected at the latter end of June than subsequently, if the weather is generally favourable for a careful search.

The following positions for Paris midnight are deduced on the assumption that the comet will arrive at perihelion Sept. 1st, the most probable date:—

		Right Ascension.		N. Declina- tion.	Distance from earth.	Intensity of light.
		h. m. s.				
June	15	... 15 34 44	...	5 6	... 0.667	... 0.90
"	19	... 15 32 15	...	4 17	... 0.659	... 0.95
"	23	... 15 30 20	...	3 20	... 0.654	... 0.99
"	27	... 15 29 5	...	2 15	... 0.651	... 1.03
July	1	... 15 28 31	...	1 1	... 0.649	... 1.06

THE RECENT TRANSIT OF MERCURY.—In the instructions for observing this phenomenon suggested by Prof. Newcomb, and circulated by the United States Naval Observatory, it is remarked that "its accurate observation is of especial importance as affording data